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ABSTRACT

The Zimbabwe Secondary School Science Project (ZIM-SCI) developed student study guides, corresponding teaching guides, and science kits for a low-cost science course which could be taught during the first 2 years of secondary school without the aid of qualified teachers and conventional laboratories. This teaching guide, designed to be read in conjunction with the related student guide, includes instructional strategies, lists of required materials, laboratory procedures, and other information for a four-part unit in which students perform activities and experiments which trace the path of energy found in food. Areas investigated include: (1) food chains and webs (introducing producers, consumers, and decomposers); (2) organisms found in milk; (3) compost and fertilizers; (4) nature and identification of fats and proteins; (5) diets; (6) balanced meals; (7) energy measurement in joules; (8) digestive systems, focusing on the human system; and (9) anatomy and physiology of human teeth. A discussion of how concepts are developed in the unit is provided. Each section in this guide correponds to a given section in the student study guide. (JN)

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ZIM-SCI

ZIMBABWE SECONDARY SCHOOL SCIENCE PROJECT

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TEACHER'S GUIDE UNIT G2

Living Things and Their Food

SE 043 852

UNIVERSITY OF ZIMBABWE
AND MINISTRY OF EDUCATION AND CULTURE

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Concept Development for Unit G2

Following on from G1 where photosynthesis is found to be the chemical reaction on which all life depends. G2 traces the path of the energy in food.

The stored energy passes along a chain, from one organism to another, becoming less as it does so, each organism using up some of it. Much is lost to the atmosphere as it passes from plant to producer to primary and then secondary consumer.

Animals and plants are seen to be inter dependant, in a balance which can be upset by various factors. Food chains become linked in food webs.

A study is made of dead organic material and it is found to finally broken down by scavengers and the decomposing fungi, and bacteria. They get their energy from it, and release carbon dioxide, water and minerals. Energy is finally lost from the food chain as the last of the food is broken down by scavengers and decomposers to water, carbon dioxide and mineral residues. The carbon dioxide water and minerals are returned to the life system but the energy is not.

The return of minerals to the soil is important to the growth of new plants and the value of compost and fertilisers is discussed briefly.

Fats and proteins are studied and tests for their presence learned. A brief description of their composition and digestion is followed by their needs in human diet, and what constitutes a balanced diet.

Pupils are introduced to the idea that energy can be measured in units called joules, and perform a simple experiment to find out how this is done. The digestive systems of animals are seen to differ in length and complexity according to diet and animal size.

An outline of the human system is studied and pupils are told the position of the glands which produce digestive juices. The different food groups are shown to be digested by different enzymes in various parts of the digestive system. The study of the mamalian mouthparts shows that they are adapted to feeding habits and an animal can be classified as a herbivore, carnivore, or omnivore on the basis of its teeth. Insect mouth parts are adapted to chewing, biting or sucking depending on the diet too, and the insect can be classified as a herbivore, carnivore or omnivore on the basis of its teeth. Insect mouthparts are adapted to chewing, biting or sucking depending on the diet too, and the insect can be classified as a parasite, scavenger etc...

A simple description of human teeth and their functions is given. Finally the existence of certain bacteria (decomposers) which are detrimental to health (those on teeth and those carried by flies) are discussed.

AIMS OF THIS UNIT

At the end of this unit the pupils will be able to :-

1. Demonstrate that living and dead materials form part of the structure of the soil.
2. Give examples of food chains and describe the movement of energy along them.
3. Explain the decreasing number of animals involved as food for others in each successive link of a food chain.
4. Describe the dentition (teeth) of herbivores, omnivores and carnivores and the mouthparts of some insects.
5. Explain the need for a balanced diet.
6. Compare the types of digestive systems in different animals.
7. Apply the scientific principles in this unit to better health practises.

In this unit there are few experiments and they are mostly short easy ones. The problem may lie in finding small animals in the winter term. If they are impossible to find, you may have to proceed without doing a particular activity or dissection. However, it is most important that at some time during the year you return to these activities and carry them out. A revision period in the last term would be a good time to do this. Do not forget to prepare ahead for pages 14. 17, 18, 19, 20, 23, 24, 33, 35, 36, 44, 47 54 62 & 70 in the study guide
At the end we have included some discussions on better health practices which flow from the scientific principles which the pupils should have learnt in the unit.

Exercise 1 Page 6 FOOD CHAINS

Allow the pupils to use the list given or draw on their own experience. Use the list yourself to check their food chains.

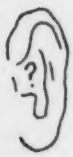
Some Examples

leaves ----→ snail ----→ tortoise ----→ secretary bird

water plants ----→ fish ----→ grey heron

sugar cane ----→ cane rat ----→ jackal

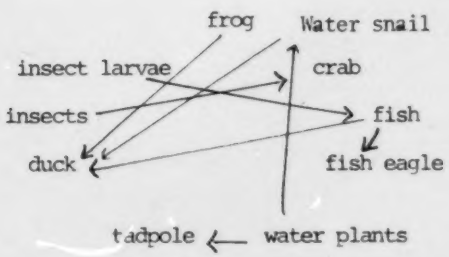
leaves ----→ locust ----→ lizard or frog etc.



Food Webs Page 8

One way to do this is to ask the pupils for the names of animals they know of living in or near a river. These may include fish, frogs, mosquito, larvae, fish eating birds.

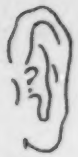
Ask what these animals eat and then put the names up in a circle on the board like this :



Then connect up the names by putting arrows from the organism which is eaten to the animal which eats it. (more than one producer plant may be included).

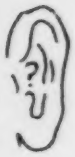
N.B. (in the study guide on P.8 change the direction of the arrows between the maize and the cow - it is incorrect in the diagram)

If the pupils have no knowledge of river life, use a ditch or hill, or a field which they know as an example instead.



Discussion on Pictures Page 8/9

1 secondary consumer needs to eat many primary consumers to live. Often but not always, secondary consumers are larger than primary consumers.



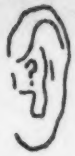
Discussion Page 10

Floods and droughts are natural ways of controlling the animal populations. In years with good rainfall plants grow well and animals increase in numbers. When a dry year follows the plant growth is poor, and the plant eating animals have little food. The young and the weak die off. What do you think happens at first to the numbers of secondary consumers?

Answer - Yes, they would not suffer as much to begin with as their food would be more readily available. Later, however when the number of herbivores become less, they would have more difficulty finding food. Their numbers would decrease too."

"Man should always be very careful when he moves into a natural area and changes it to suit his ways of living. No one likes snakes, so people kill or drive them off. If people kill off snakes, the rat and mouse population will increase, and man's store of grain may be invaded - the same may happen if jackals are poisoned in great numbers.
People have become concerned that using insecticides to kill undesirable insects may also result in killing useful ones - like the bee which pollinates flowers. If flowers are not pollinated seeds do not grow and poor crops result."

"If a farmer buys a piece of land in a normal season and introduces a small herd onto it, he may be tempted to let that herd increase in numbers in a good year. However, during drought years he should reduce that herd on that grazing land or move them to another piece of ground before it grazes the natural grass down to the roots. If the green shoots of grass are continually eaten as soon as they appear, the plants get no chance to photosynthesise and build up a food reserve for winter. Thus the next growth is poor, and the land is damaged."



PAGE 13

Read through page 13 with the class to ensure that they understand the impala/cheetah calculation.

Activity 1 Page 14 Watching decay take place

You will need :-

3 wide mouthed bottles (jam jars will do)
1 piece of fruit such as a tomato, orange or mahobhobho
1 dead fly
1 piece of bread or some cooked sadza/ ishiswala

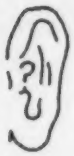
In to the first bottle, pour a little water. If you can get a few drops of pond water, this will speed up the decay. Add the dead fly. In the second bottle, place the fruit, the skin of which should have been cut by you in a few places.

In the third place a slice of wet bread or slice of sadza/ ishutswala, keep it damp. Place all three where the pupils can see them each lesson. Do not screw the lids onto the jars because this will encourage disease

Give the pupils a chart like this in which to record their observations. We have filled in the first section with typical observations. Of course the children will put their own observations instead!

DATE	SAMPLE	APPEARANCE
TUES 4th	Fly	No change
	Fruit	Strong smell, Visited by flies
	Bread	Grey Spots appearing
WED 5th	Fly	
	Fruit	
	Bread	

Pupils should notice change in colour, shape, size, smell of fruit, visits by scavengers etc. They may smell the decaying fruit, but should not put their noses too close to the neck of the jar.



Page 15-17 Scavengers

Ask the pupils what the first 3 animals are - they will probably recognise a vulture, jackal and hyena. Termites, often known as white ants,, seldom have wings. However, pupils will know the winged form which start off to form new colonies as flying ants and may have eaten them.

The woodlouse is grey and has many legs which do not show in the picture.

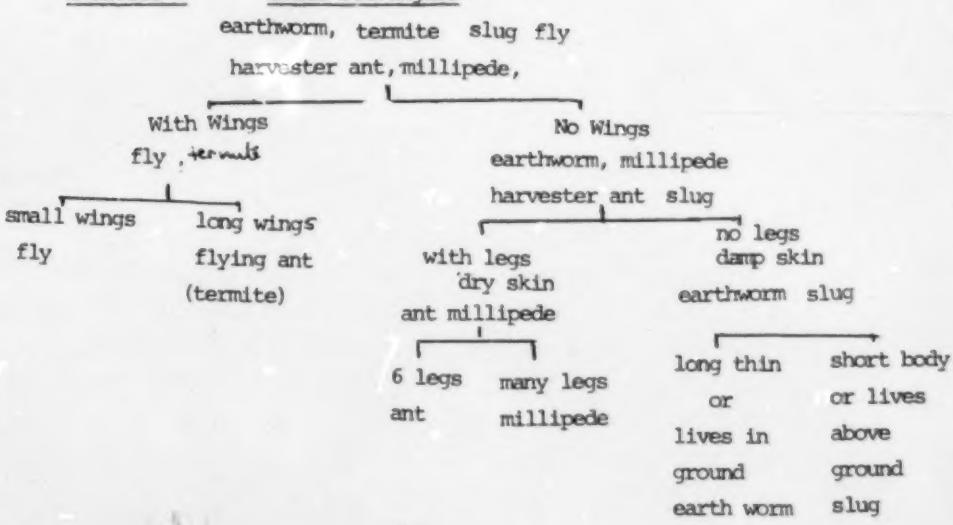
N.B. Do not forget to tell children these pictures are not drawn to scale i.e. we do not have slugs and termites as big as jackals!

Activity 2 Page 17

Visit likely places yourself before the lesson and pick some where specimens can be found. When you take the pupils outside take care they do not go where there are likely to be snakes and scorpions.

A suggested key using some of the animals in the pictures.

Exercise 2 Small Scavengers



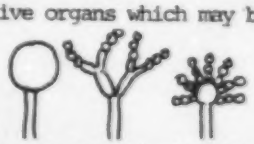
Their description of animals should include such details as

Size
Presence or absence of wings
No. of legs
Colour
What it eats
Hairiness or scaliness
Parts of body eg. 1, 2 or 3 or many segments
Speed of movement etc.

Activity 3 Page 18

1 week before the lesson, put wet bread or sadza (bread is better) into a bottle, keep damp but do not seal the bottle.

The pupils should come to you with their biomounts. Using tweezers, give them a few threads of fungus taken from food in the bottle, onto the biomounts. Do not worry if the amount you give them seems to be almost nothing! There may be several different fungi on the food - orange, green grey or white. Give some pupils samples of one kind and other pupils samples of another kind. Allow them to look at each others samples. Try to put one example of each kind under your microscope. Look for the reproductive organs which may be something like one of these.



DIAGRAM

Remember do not breathe air from the bottle and wash hands after this activity as the decay organisms may be dangerous to your health.

Organisms in Milk Page 19

Please try to obtain some cow or goat milk a day or two before the lesson and leave it in the cupboard to go sour. About 50 ml in a jam jar will be enough. It will make your lesson more effective to experiment on the real thing instead of just discussing it. Lacto or yoghurt will also do, but unfortunately condensed or powdered milk tend to develop fungus spots and may give the wrong idea.

If you have sour milk, get ready also a piece of thread
1 plastic bag
1 small plastic bottle containing some purple bicarbonate indicator.

Pass the sour milk around for the pupils to look at and smell (but NOT touch). Ask them how they can test for the presence of micro organisms which they cannot see. Remind them of their work in Unit G. They should remember that living things respire, and give off carbon dioxide which turns bicarbonate indicator yellow.

Put the sour milk and the bottle of indicator in a plastic bag and tie closed with the thread. Place on one side for the pupils to look at later. They will find the indicator turns yellow showing that living things are probably present in the milk.

You have no milk, this will just have to be a discussion session.

Experiment 1 Page 20

You will need :

5 buckets of water (if the soil is dry)
At least 4 spades or badzas
Gas burner
Retort stand with triangle fixed on it
Boiling tin and evaporating dish
1 square aluminium foil
Spatula/stirrer
Peg
Water
1 plastic bottle
50 ml purple bicarbonate indicator (class strength as made up in Unit F2 and G1)
Plastic Bags
Thread
Pieces of paper for labels

P

Try to find a place near the school where either compost has been added to a vegetable bed or leaves and grass are lying on the ground. A few pupils may dig some small holes, and take a slice from the sides as in their diagram.

After the pupils have brought their soil samples inside, collect about half a plastic cup of soil from the pupils to use for the control. Place it in a boiling tin and cover with a lid. Add enough water to the soil to be sure it is just wet. Heat it over your gas burner for 10 minutes to kill any organisms in the soil. Using a peg to hold the tin, scrape out the soil onto a square of aluminium foil. Spread it out with a spatula and allow it to cool. Put the cooked soil into a clean plastic cup, Place it together with the bottle of purple bicarbonate indicator in a plastic bag. Tie closed and label it "control"

Find a safe place for the students experiments to be left along with your control. Depending on the amount of humus in the soil, the indicator may change to yellow in an hour, or take days.

Exercise 3 Page 22

At the start of the experiment the colour of the indicator was _____ in my bottle and it was _____ in the bottle in the teachers control. After some time the colour of the indicator in my bottle was _____ and it was _____ in the bottle in the teachers control. This showed me that _____.

Exercise 3 Page 22

Answers :

Purple, purple (hopefully) yellow, purple.

This showed me that there were possibly living organisms in my soil which were respiring. In the teachers' control there were no organisms respiring as they had been killed by heat.

N. B.

If time is limited you need only do either Experiment 2 or 3. If you have access to a compost heap it would be preferable to do experiment 3.

Experiment 2 Page 23

You will need :

2 cupfuls of cooked sadza/isitshwala

2 cupfuls of dry mealie meal

4 jam jars

4 plastic bags

2 plastic bottles containing some purple bicarbonate indicator

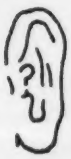
Newspaper

Fill 2 jam jars with dry mealie meal. They are the control\$ Cut the sadza into 1cm3. Fill the last 2 jam jars with the cubes.

(a) Take 1 sample of dry mealie meal and one of sadza Place each jar (open) in a plastic bag together with a small bottle of bicarbonate indicator in a plastic bag. (see diagram in pupils books). Tie the bags closed with thread. (In a few days pupils should observe the indicator turn yellow showing the possible presence of organisms using up the food - or decaying the cooked mealie meal. The indicator should not change colour in the control).

(b) Use the other 2 samples, one cooked and one dry, to test for any temperature change.

Wrap as many layers of newspaper as you can around each jam jar, but do not quite seal the top. (Decaying food which is sealed can develop nasty organisms). Insert a thermometer into each jar. Ask a pupil to read the temperature. Pupils should record this in their books.
At the start of each lesson for a week or two, the temperature should be recorded again. A difference of at least 2°C should develop between the control and the experimental jar.



Discussion on Control for Experiment 2

Although pupils may point out that sadza being cooked has probably no live micro organisms in it, you should point out that new living micro organisms can enter the food from the air - (even the cooked soil in experiment 1 would have new micro organisms in it after a few days). The dry sample can be used as a control because micro organisms do not grow without water.

Exercise 4

1. The bicarbonate indicator in the bag with the sadza turned from _____ to _____ showing that _____ was being given off. The bicarbonate indicator in the dry maize meal control was _____. This indicated to us that _____.

(2) The temperature of the wet maize meal at the start of the experiment was _____. At the end of the experiment it was _____. The temperature of the dry maize meal control at the start of the experiment was _____ and at the end of the experiment the wet sadza was _____oC higher than the dry. This showed that _____.

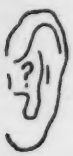
(3) The energy came from _____.

Answers to Exercise 4 Page 23

(1) Purple, yellow, carbon dioxide, not changed/stayed purple, Organisms may be respiring

(2) As recorded.
heat was being given off by something in the sadza but not in the control.

(3) The sadza

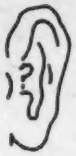


MAKING COMPOST - Page 24

A compost heap needs (1) Plant material (2) Soil (3) Water (4) Ideally some manure (5) Air

A well constructed compost heap brings the plant material into contact with soil (containing micro organisms), water and air. The pupils may have learnt about compost in their agriculture lessons. The poles in the picture are useful to keep a heap tidy but are not essential.

However, they do give the idea of alternate layers of soil and organic material. The bucket is to remind pupils of the need for water and the soil is to cover the heap when complete.



HOW TO MAKE A COMPOST HEAP

A compost heap is best started by laying some sticks and twigs on the ground. On top of this should be placed plant material - old vegetable peelings, weeds, grass or dead plants and leaves. This layer must be covered then with soil and watered well. Now more plant matter may be added as it is gathered and this subsequently covered with soil and watered.

Present in soil are small organisms (as already discovered by the pupils) which pass into the plant material and start to break it down. Water is needed as organisms cannot be active without it. Dry compost will not break down.

If manure is available this will improve the compost if it can also be spread in a layer on the heap. When the heap is high enough it should be covered with soil to prevent flies breeding in the rotting vegetation. After a few weeks, during which the heap is kept watered, it should be "turned". The top layer is removed and laid out next to the heap. Then the layer second from the top is also removed and placed over it, until the whole heap is reversed. This allows fresh air to reach the bacteria as they need it for respiration.

If you insert a metal rod into the heap with the end sticking out, this will act like a permanent thermometer. You can touch it each morning to find out how hot the heap is inside, when it is hot, material is decomposing.

If cold, it means the heap has either not started to decompose (maybe its too dry) needs turning, or is finished and ready to use.

Experiment 3 Page 24

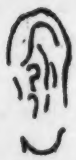
If you have tested the compost heap and found it to be hot, proceed with this experiment.
Provide the pupils with spades, thermometers, bicarbonate indicator etc. as in the pupils guide. Take them outside to the heap to conduct the experiment. If any leaves with grey threads are seen, put one on a slide under the microscope for pupils to view.
Take note of any ants, or other scavengers which may be active at the base of the heap.

Alternative Exercise 4 page 25

1. The temperature of the compost heap was _____oC higher than the air temperature.
2. The bicarbonate indicator turned from _____ to _____ which showed that _____ was being given off.
3. These two facts indicated that _____ were _____
4. The source of energy was the _____

Answers :

1. recorded difference in temperature
2. purple, yellow, carbon dioxide
3. organisms respiring
4. dead plant material and animal waste



Answers to Questions on Bioset ZS/3 Page 26 Which You May Discuss with Pupils in Class

Activity 4

(1) A fly pours saliva on to food or decaying matter, to soften it, then sucks up the partly digested liquid food.
A flea pierces an animals skin and sucks blood.
A locust eats fresh plant material cutting it off from the plant with chewing jaws.

(2) Saliva is a liquid produced in the salivary glands.
Saliva contains a digestive enzyme. The relevant slides are 2 and 4.

(3) A scavenger feeds on dead organic material. They clear the soil of excess dead material.

(4) Bacteria come in 3 shapes.

Round - the cocci
Spiral - the spirillum (like the spiral of a snail shell)
Rod - the bacilli
They decompose waste into simple compounds.

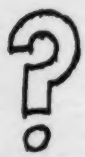
EXERCISE 5 (Page 26)

1. What other animal have you studied which feeds in a way similar to the nematode?
2. Where have you seen a decomposer plant like the pinmould?
3. Complete these sentences :
   a nematode is a .....
   a pinmould is a ....
   bacteria are .....
4. Write out two food chains which include a scavenger and a decomposer.

Answers

1. Earthworm
2. on decaying bread
3. scavengers or parasite, saprophytes, decomposers/ micro-organisms.
4. The food chain should include
   (a) Producer (green plant)
   (b) One or 2 consumers animals eg. Primary, secondary scavenger
   (c) Decomposers - fungus or bacteria

eg. plant → primary consumer → bacteria
plant → primary consumer → secondary consumer → fungus
plant → scavenger → bacteria
(plant → fungus is not incorrect)



Page 29 Answers to How Much Do you Know? Part 1

1. Producers (manufacturer)
2. Consumers
3. Secondary consumers
4. Primary consumers (herbivores)
5. Scavengers
6. Saprophytes
7. Green
8. Decomposers
9. Organic
10. Organic - manure
11. Minerals
12. Food
13. Food Chain
14. Food webs
15. Pyramid of numbers - primary—secondary consumers
16. Nitrogen —phosphorous —potassium —fertiliser/minerals/compost
17. Legume, nitrogen fixing

page 33

Experiment 4 A Simple Test for the Presence of Protein

You will need some egg white

A small quantity of egg white may be collected from an egg to be eaten by your family - a teaspoon full is enough!
Mix one teaspoonful of egg white with 50 ml of water. Shake well. Give the pupils a few drops each.
(N.B. Egg white will keep for a few days).

Exercise 6 Part 1 page 34

(1) The albustix changed from _____ to _____.
(2) When protein is present an albustix turns _____.

Answers

Yellow, green, green

Page 34

Plants which store food as oil : Sunflowers' seeds, peanuts, caster oil seeds, cotton seeds, etc.

Experiment 5 Page 35 A Simple Test for Fats

You will need to have ready :

cooking oil (about 2ml) OR a
small cube of margarine / lard or cooking fat.
(Oil can be obtained from the top of peanut butter)
Filter papers
(Ordinary paper - even the unprinted edges of newspapers can be used instead of expensive filter paper)

Methylated spirits

Droppers

Water

Make sure the pupils understand the word translucent. (Translucent mans light comes through but you cannot see objects through the material.) Stretch out a piece of string in a tree or across a window for the pupils to peg up their papers.

Exercise 6 Part 2

When I first held the paper up to the light, the three circles were _____. After drying I held the paper up to the light again.

1. The water circle was _____.
2. The meths circle was _____.
3. The oil/fat circle was _____.

Conclusion : Fat leaves a _____ mark on paper. Other liquids such as water and meths _____

Answers to Exercise 6 Part 2

1. Unmarked
2. Stained pale purple but not translucent.
3. Translucent.

Conclusion : Translucent - evaporated and did not leave a translucent mark.

Experiment 6 A or B Page 36

Provide either some crushed nuts, some peanut butter or fresh milk (whichever is available)

Quantities Required :

Nuts or peanut butter ½ spatula per pupil pair OR

Milk, about 2 ml per pupil

Have ready :

clinistix, albustix, iodine solution and filter paper or clean newspaper.

Whole milk should show the presence of glucose sugar, fat and protein but not starch.

Peanuts/peanut butter show the presence of oil and protein

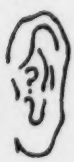
TABLE TO GIVE PUPILS Exercise 7A or 7B

Sample	Test Used	Result	Conclusion

Conclusion : My food sample contained _____

For Example :

Sample	Test	Result	Conclusion
Nuts	Oil test on paper	Translucent mark left	Fat present
	Albustix	turned green	Protein present



Discussion on Meals Page 42

Sadza, potatoes, rice, toast/bread, mealies provide the basic carbohydrate energy foods.
Cooking Oil, margarine, butter, peanut butter are extra energy sources as they contain a lot of fat.
Meat, chicken, fish, flying ants, milk, eggs, sausage, peanuts nyimo, peanut butter and cheese are rich in protein.

Peas, rape, tomato, bananas, oranges, pumpkin leaves, carrots, cucumbers etc. all provide some vitamins and minerals.

Chicken, fish, flying ants, eggs, sausages, milk, peanut butter contain fats, proteins and often some minerals too.

Exercise 8 page 42

Make sure that pupils include in their balanced meals

(1) a protein food
(2) an energy food (carbohydrate only or carbohydrate and fat)
(3) Vegetables or fruit for the mineral and vitamin content.

Exercise 9 page 43

These 3 meals are not balanced. What could you add to balance them?

(1) Fish and potato chips
I would add _____ as the _____ food is missing.
(2) Cooked pumpkin and butter and tomatoes.
I would add some _____ as the _____ food is missing.
(3) Tea with sugar, a bun and jam.
I would add _____ and _____ as both the _____ food and the _____ food is missing.

Answers :

(1) I would add vegetables and/or fruit as the vitamin and minerals for health food is missing.
(2) Meat or fish (or other protein) as the protein/body building food is missing.
(3) I would add some meat or cheese etc. and some fruit (or vegetable) as both the body building food and the food to keep our body healthy (vitamin and mineral food) is missing.

N. B.

The main purpose of experiments 7 and 8 is to find out if different foods contain different amounts of energy for the same mass. In these experiments pupils discover that oil contains more energy than mealie meal.

Experiment 7 Page 44

To prepare the mealie meal strips :

You will need :

2 ml measure only just filled to the top with mealie meal. We have found this to have a mass of close to 1g on our sensitive balance.

an evaporating lid

5 ml water

pupils burner and stand

meths burner

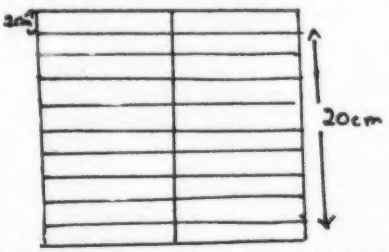
spatula/stirrer

2 squares of Mutare paper or newsprint paper 20 cm x 20 cm

P

Mark the paper in this way with pencil and ruler.

As in Diagram below :



Now cook the mealie meal until it becomes thick and sticky. Not too dry! Allow it to cool, then spread all of it evenly all over the paper. It will only coat it very thinly. The idea is to get approximately 0.05 g meal on each strip. Allow to become almost dry then cut along the lines to make 20 strips. Now dry the strips completely.

Make another 20 strips from your second square by ruling lines as shown and cutting them out. Give each pupil pair a plain strip of paper as a control and one coated with mealie meal.

Exercise 10 Page 44 Table To Give Pupils for Experiments 7 and 8

Part 1 Experiment 7

(1) Mealie meal ____°C

Temperature of water ____°C

Temperature of water after paper burnt ____°C

Temperature rise caused by paper burnt ____°C

Temperature of fresh water ____°C

Temperature of water after paper and mealie burnt ____°C

Temperature rise caused by paper and mealie meal ____°C

Temperature rise caused by mealie meal alone ____°C

Therefore 0.05 gr. of mealie meal contained enough energy to cause a rise of _____oC in 50 ml of water.

Part 2 Experiment 8

(2) Oil

Temperature of water _____°C

Temperature of water after paper burnt _____°C

Temperature rise caused by paper burning _____°C

Temperature of fresh water _____°C

Temperature rise caused by oil alone _____°C

Therefore 0.05 g of oil contained enough energy to cause a rise of _____oC in 50 ml of water

Page 46

Is this class sure that all the heat energy released went into the water? Much of the heat is being lost to the air and does not reach the water. Some water was also probably present in the mealie meal as it was not oven dried. Also the maize meal was not accurately weighed.,

Experiment 8 page 47

You will need :
2 ml oil and several droppers
2 squares of paper 20 cm x 20 cm each cut into 20 strips as in experiment 7. Give each pupil 2 strips of paper. They can come up to you to get 3 drops of oil placed at intervals along 1 strip so that they spread into the paper.

We found that the average mass of 3 drops of oil from the Zim-Sci droppers to be 0.05 g. (Try not to use droppers with a broken end, as they may not give the right size of drops).

Exercise 11 Page 48

Up to now the pupils have only measured the temperature rise in water, caused by the release of energy in the food. In order to calculate the amount of energy, they have to take into account the thermal capacity of water. Read through the definition of a Joule with them. Also work through this example before they do Exercise 11 so that they can see how to do the calculation.

Calculation Example :
When a similar experiment was done under accurate conditions the temperature rise caused by burning 0.05 g of flour was 3.65 ^{o}C

3.65^{o}C rise in temperature was caused in 50 ml water by 0.05 g flour

1^{o}C rise in temperature would be caused in 50 ml water by $\frac{0,05}{3.65}$ = 0.014g

1^{o}C rise in temperature would be caused in 50 ml of water by

$$\frac{0.05}{3.65} \times \frac{1000}{50}$$

$$= 0.27 \text{ g}$$

It is a known scientific fact that : -

1^{o} Rise in temperature would be caused in 1000 ml of water by 4200 J

Point out now to them that therefore 0.2& g of flour must have released 4200 Joules so 1 g of flour would produce $\frac{4200}{.27}$ = 15 500 Joules (Approx.)

How many grams of oil or mealie meal released 4200 Joules? They will find out from their own calculations.

N.B. Pupils will not be expected to do this sort of calculations in their exams. If you feel it too difficult for them to Exercise 11 leave it out. Your demonstration of the above calculation would be sufficient to show the principle.

Exercise 12 page 49 Maize meal needed by Farmer doing hard work.

A farmers total energy need is 24 000 KJ per day
There are 16 KJ in each g of maize
Therefore the maize meal needed per day is

$$\frac{24000}{16} = 1500g \text{ (answer)}$$

Small child

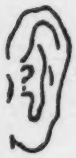
A young childs total energy need is 8 000 KJ per day
A quarter of this total need is 2 000 KJ per day
Fat contains 40 kJ per g
If he gets a quarter of his energy from fat then he will get -

$$\frac{2\ 000}{40} = 50g$$

Answer 50g of fat per day

N.B. (One would not feed a child 50g of fat per day. the figures were chosen to make an easy solution)

Page 51

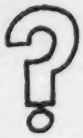


PIE CHARTS

The pupils do not have to learn by heart the proportions in each pie chart. You could ask them questions such as :

(1) Which 3 foodstuffs contain the greatest amount of protein?
(2) Which 3 foodstuffs have the most fat?
(3) Which 3 foodstuffs have the most carbohydrate?
(4) Which 3 foodstuffs have the most water?

(5) Which 3 foods have the least protein?
(6) Which 3 foods have the least fat?
(7) Which 3 foods have the least carbohydrate?



Answers to : How Much do you Know? Part II Page 52

1. Plants
2. Animals
3. Plant
4. Animal type
5. Carbohydrates, minerals
6. Albustix, yellow to green
7. Energy
8. Translucent mark
9. Kind, quantities, (tell pupils to change "is" to "in")
10. (a) Energy (b) Build Bodies (c) Healthy
11. Energy
12. 1 kg of water 1° Celsius

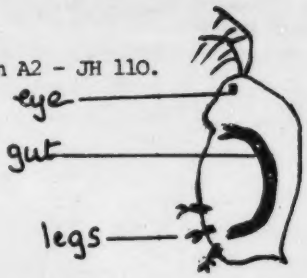
AS IN EXPERIMENTS 7 or 8

ACTIVITY 5 page 53

You will need the biosets used in A2 - JH 110.

DAPHNIA

DIAGRAM



The diet consists of very small wet particles of plant material or micro organisms so there is no need for any special organ to break down food into small pieces. Being such a small animal a long complicated gut is also not necessary. Enzymes are merely poured onto the food in the first part of the gut, and then the food is digested and absorbed further down the gut as it passes along.

DISSECTIONS OF SMALL ANIMALS :

You may choose to dissect either the earthworm, cockroach, or locust or all of them depending on what animals you are able to obtain. These dissections are delicate, but not time consuming or really difficult, it is suggested that you practise on one or two animals first!

In either case kill the animal by holding with forceps and dipping it into boiling water out of the sight of the pupils.

To do the Dissection

You will need :

a piece of wood or cardboard
pins
mounted needle
forceps
sharp razor blade or scalpel

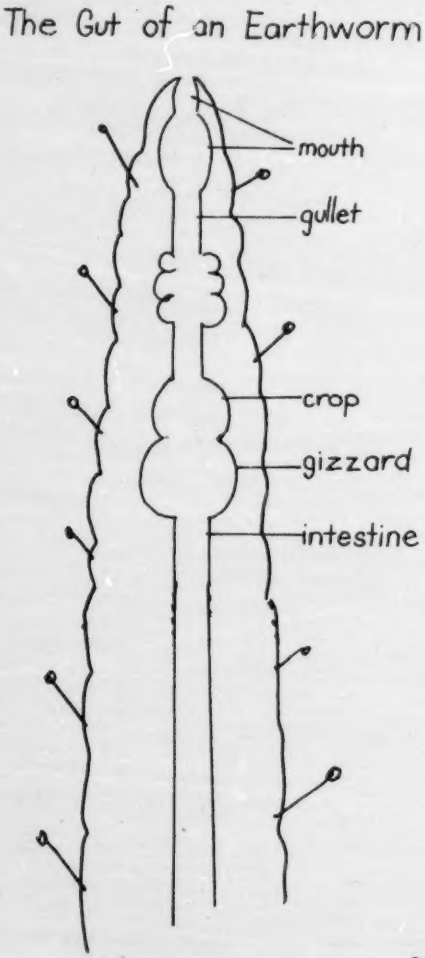
Dissecting the Earthworm

When you have killed the worm, lay it out straight on the wood or card. Very lightly run the blade down the length of the worm. Using pins separate the two cut edges of skin and pin them back all the way down the worm. If the inside of the worm is very muddy, you have cut too hard and broken the gut and need another worm. The gut should lie like a thin tube right down the worm - see diagram.

You can now identify the mouth end, because the thickened parts of the gut - the crop and gizzard are nearer this end!

Allow the pupils to feel the crop and gizzard and try to guess what is inside. Then cut it open. Grains of sand are swallowed along with leaves and other humus. This is moistened with digestive enzymes in the mouth. In the crop and particularly the gizzard the food is broken up further (a little like a persons stomach) The sand helps break up the the vegetable matter. Pupils should see that here the walls of the gut are thick and muscular. The food is now digested and absorbed as it passes along the straight intestine. Undigested and insoluble remains pass out through the anus. Pupils should note that the gut has developed specialised parts.

Diagram of Dissection

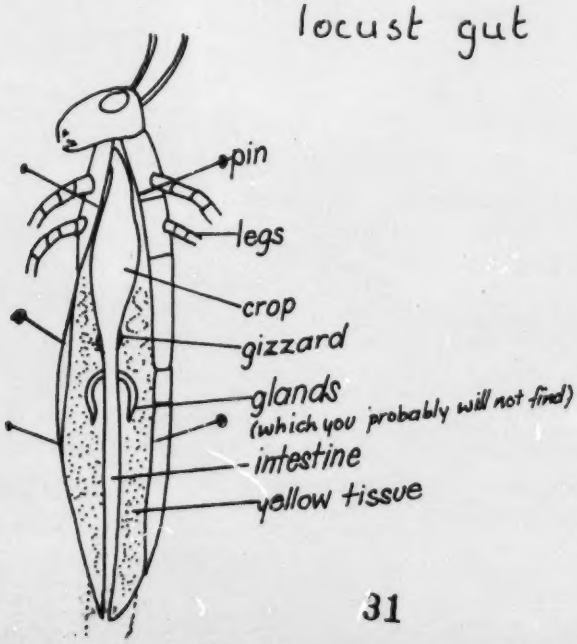


Dissection of the Locust

Try to obtain several specimens and practise on them the day before. Use a fresh one for the lesson as they go bad quickly. Hold a locust in tweezers/forceps. Have a tin of water boiling and dip the insect into the water, holding it there until dead. You will see bubbles of air coming out from its body. These are from the breathing holes along its body. Now place it, on its back and pin it down with pins through the small legs. You may find it easier if you remove the large jumping legs, Using a sharp razor blade cut down either side of the abdomen until the two cuts come together at the tip or "tail" end.

Now, using scissors cut up the thorax between the legs, up to the neck. Open this part up and remove the "lid" you have cut from the abdomen. You will find that it is almost filled with a bright yellow substance. In the thorax there is a large grey tube which you can see easily. This is the crop. Follow this tube as it becomes a narrow tube going straight down the abdomen to the tail end. Half way along this tube you may see some "glands" but do not worry if you cannot find them. You do not need to take the gut out of the body, it can be seen just as well in the body.

Allow pupils to come up in small groups while you show them the parts of the gut. You could at the same time point out the absence of lungs. They may be surprised to see how simple the gut is - no liver, no long coils of intestine etc.



LOCUST

This insect eats fresh plants. The food is well chewed and broken up as it enters the mouth. Saliva is added in the mouth. Further food breaak up takes place in the crop and gizzard and the digestion takes place along the intestines.

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4. COCKROACH

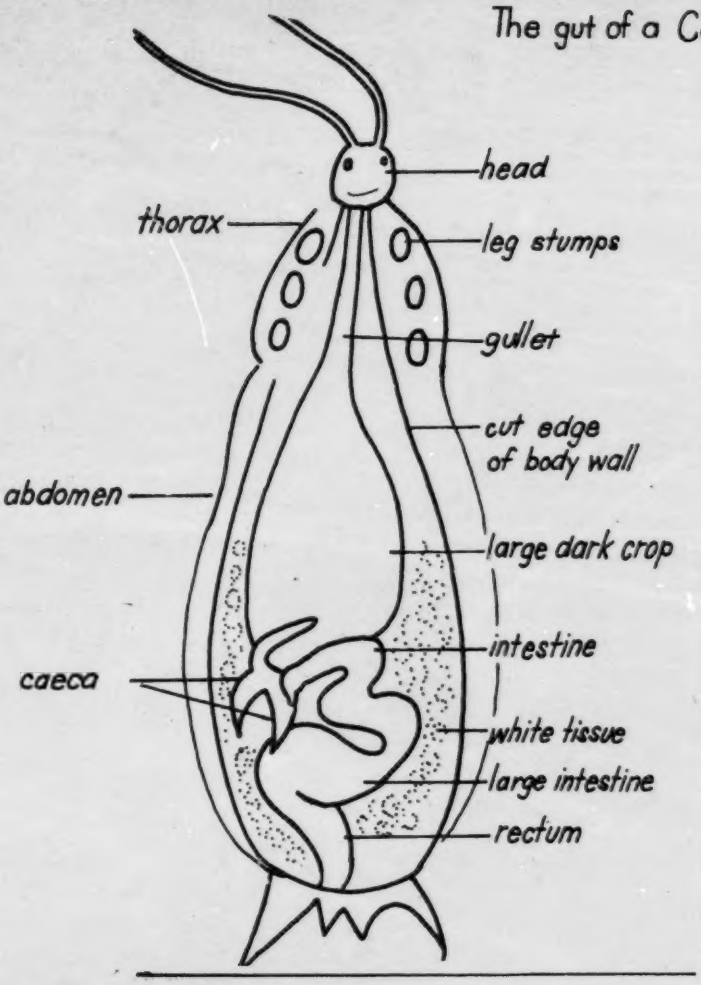
In the head there is a mouth cavity, which becomes the gullet passing along the neck into the thorax where it widens out to become a crop - a large pear shaped bag which extends into the abdomen, and is followed by a small gizzard. At the boundary of the gizzard and intestine are small fingers like caecae. There is a small intestine, large intestine and rectum - but in dissection this looks like a tube which coils once or twice.

Food is chewed into tiny pieces then saliva with many enzymes is poured into mouth from salivary glands. Much digestion takes place in the crop and the gizzard breaks up any remaining particles of food.

Dissecting the Cockroach

The cockroach is the most difficult insect to dissect and also to catch! You should have a large tin of boiling water ready into which you can quickly tip the cockroach!

Once dead cut off the legs and lay it on its back (on the wings). It is quite flat. Holding it with the forceps use a razor blade to cut down both sides of the abdomen so that you cut a "lid" off. Remove this lid altogether, and pin the abdomen to the cardboard with 2 or 3 pins. Now snip up the middle of the thorax and pin this back.
The gut is not clearly seen in the thorax region as it is very thin. However, you can find it easily in the abdomen. The crop is very large and can be seen as a big dark organ which shows up well against the rest of the white fat tissue in the abdomen. Below the crop is the small gizzard, caecae (pronounced seeky) and intestine. You will have difficulty making out which is which with the gut still in the body, so pull it out of the body. These organs will be coiled up in the lower part of the abdomen - see diagram



THE RAT DISSECTION

Follow the procedure for dissecting a rat which is given in the teacher's guide of Unit E Page 25.

Remember not to use wild rats which may be carriers of disease.

While you are doing this dissection show the pupils the lungs, ribcage, heart and diaphragm.

Also try to show the blood vessels supplying blood to the intestines. You can see them in a transparent thin plastic like tissue between the loops of the gut.

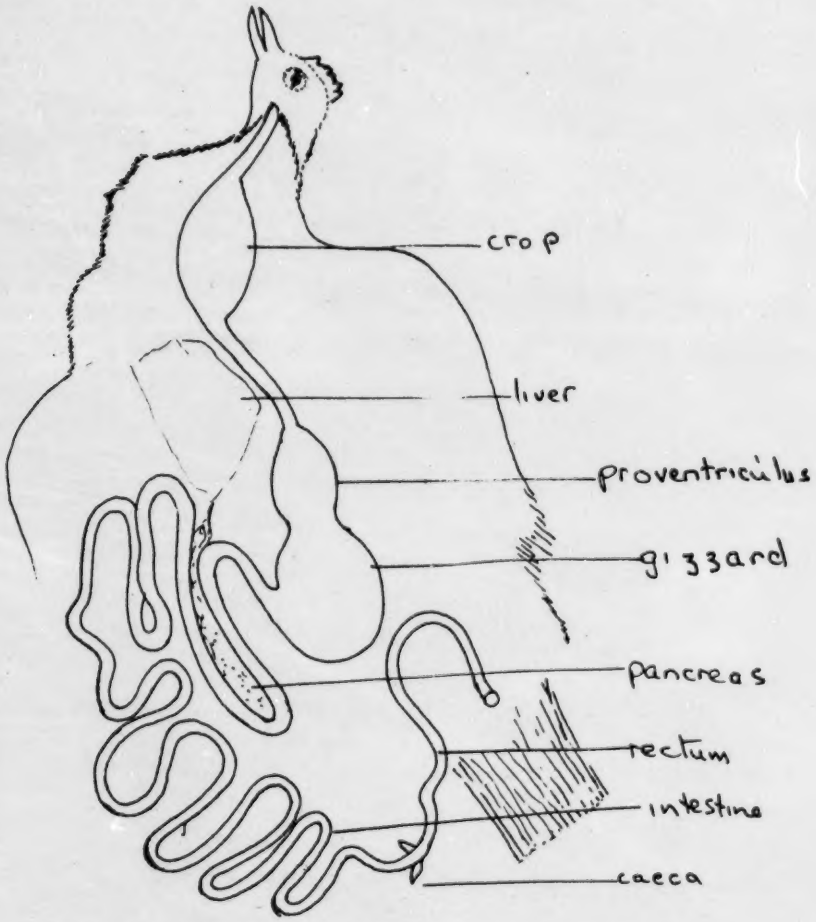
Point out again the position of the kidneys, liver and bladder. Use this dissection to revise the reproductive system too.

N.B. CHICKENS (birds)

As a last resort, if a rat is not available for dissection, the gut of a chicken could be removed from a bird someone has killed to eat.

As it is a smelly object, the gut could be brought to school in a sealed jam jar of methylated spirits and passed around the class.

Here is a simple diagram showing the parts of a bird's intestines.



A bird like a chicken eats mainly grain. It has no teeth to chew the grain, but it often picks up small bits of soil at the same time as it feeds to grind up the grain in the birds gizzard Grain is softened in the crop. Digestive juices are added in the proventriculus before the grain is mashed up by the thick walls of the gizzard. Enzymes are added in the intestine from the pancreas. A bird has a liver like other vertebrates, and pupils should notice that the intestines are very long compared tothe length of the body

Page 55 Exercise 13

The gut of daphnia is a simple tube much the same length as the animals body. The gut of a worm or locust insect is not a simple tube, but has a part for grinding and parts for digesting and for absorbing. (In some insects the gut is coiled in the abdomen, so it is longer than the body of the animal and more complicated. than that of a worm.)

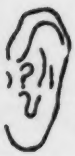
Exercise 14 page 57

Answer

There are many different kinds of proteins and most plants do not make all the special types of proteins which are needed to build up animal tissues.

With the help of the decomposers in its special gut, the primary consumer (in this case the chicken) is able to convert plant proteins from the grain into animal proteins.

Secondary consumers (meat eaters like ourselves build up animal type protein from grains. We usually have to get our body building protein from other animals like the chicken in the form of meat, and eggs.



Digesting different foods Page 58

Read this slowly to the pupils while they look at their diagram of the human gut.

When you chew your food, as you already know, saliva is added to it in your mouth. Saliva is produced by the salivary glands opening into your mouth. The saliva contains an enzyme which starts the breakdown of starch to the smaller sugar molecules.

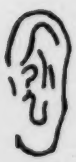
When your mouth feels that the food is chewed enough and slippery enough to pass down your gullet, you swallow it. Now it passes into the stomach. The stomach is a muscular bag with strong walls. In the walls there are special cells, which are small glands also producing different enzymes. These enzymes are poured on the food to start the breakdown of proteins. Now the muscles in the wall continually squeeze and relax, mixing the enzymes with the food.

Pancreatic juice also contains enzymes which act on starch, and proteins. Further along the small intestine there are many tiny gland cells in the wall, which pour more digestive juices onto the food. These juices complete the digestion of the carbohydrates and proteins. As the food continues along the small intestine, the tiny molecules of digested food are absorbed by the villi and pass through the intestine wall into the body itself.

Some of the food cannot be digested, and this passes into the large intestine. Here water is removed and the wastes become more solid. These wastes eventually pass out through the anus as faeces.

Now give the pupils this table to write out in their books.

Place	Gland	Juice	Food Acted On
Mouth	Salivary gland	Saliva	Starch
Stomach	Cells in Stomach Wall	Stomach Juice	Proteins
Small Intestine	Liver	Bile	Makes fat drops smaller
Small Intestine	Pancreas	Pancreas Juice	Proteins, fats and other carbohydrates
Small Intestine	Cells in intestine wall	Intestine wall	Proteins and Sugars
Large Intestine	-	-	Water absorbed



Then ask these sort of questions, "What is the juice called which is produced by the salivary gland?"
Answer : - Saliva.

Have you ever eaten tripe? It is the stomach of an animal. Has anyone noticed how thick the walls are? These walls contain the cells in which protein digestive enzymes are made.

"I am sure some of you have eaten animal liver - can anyone say what colour it is? Answer :- a dark red-brown colour. It is a separate organ, as you saw in the rat dissection. A tube leads from it to the first part of the small intestine and liver juice (bile) passes along it to be poured onto the food. What does bile do?

Answer It acts on fats

If you have been lucky enough to visit your uncle when he is killing a beast you may have received the part which through custom is always yours!

This part is the pancreas (sweetbread, rwatata or udakada) What does the juice from this gland act on?

Answer: protein,fats and carbohydrates.

Are any more enzymes added after those from the pancreas?

Answer : - Yes, there are little gland cells in the walls of the small intestine which produce enzymes.

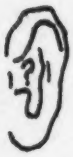
What happens along the rest of the small intestine?
Answer : - Digested food is absorbed by the villi. Is any digested in the large intestine?
Answer : - No, but some water is absorbed into the body.

Exercise 15 Page 58

1. Saliva acts on _____.
2. Stomach juices act on _____.
3. Bile is produced by the _____.
4. Pancreatic juice is made by the _____ and breaks down _____.
5. Cells in the small intestine make enzymes to break down _____ and _____.
6. Further along the small intestine finger like _____ absorb the digested _____.
7. In the large intestine _____ is absorbed.

Answers :

1. Starch
2. Proteins
3. Liver
4. Pancreas, fat, protein, carbohydrates
5. Sugars and proteins
6. Villi, food
7. Water



Page 59 TEETH

Say to the pupils,imagine you are holding a banana or tomato, pretend to take a bite from it. Lets see you do it! Which teeth would you use? Yes, your front teeth. They will cut off the soft plant material for you.
Now imagine you have a bone, with a piece of meat on it, or a stick of dry biltong (chimukuyu). Which teeth would you use to bite off some meat? Yes, you would use teeth at the side of your mouth, nearest the front - the "corner" teeth we can call them. You would hold the meat with them and pull at it! Now pretend you have bitten off some food and are chewing it to make it smaller. Which teeth are you using now? What are you doing with them? Yes, you are moving your jaw up and down and from side to side to grind the food into smaller pieces with your large teeth near the back of your mouth.

Point to your own teeth as you read the next part. In the front of your mouth you have teeth called incisors which pass each other as you bite. These teeth, have a scissor like action for cutting off food. Incisors are very important in herbivores, for biting off vegetable material. Next to these, are the pointed canine teeth. We do not have very much use for them, but which have to kill to eat, have big ones to fight, rip and kill!

Next come the pre-molars . We have 2 behind each canine tooth. Each pre-molar has 2 points. In our mouth the pre-molars and the molars meet and grind up our food. The molars are the large teeth with 4 points at the back of the jaw.

Adults have 4 more than children - called wisdom teeth.

In a meat eating animal, the pre-molars are sharp, and they pass each other to cut and tear meat and crunch bones. Carnivores mostly swallow their food in quite large chunks, but there are some molars at the back of the jaw which meet and chew.

Now identify your teeth in Activity 6

Diagram error

N.B. In the plan only the first of the molar teeth has been labelled a pre-molar, this label should include the first two molars. Pre-molar teeth have 2 "points" and true molars have 4 "points".

Ask pupils to correct this label in their books as in this diagram.

Exercise 16 Page 60

Answers :

A dog has large canines because dogs need strong sharp teeth to catch and kill other animals. They do not need long incisors to cut off grass or plant material as they do not eat plants.
(Domestic dogs may be fed bread or cooked maize meal but their natural food is meat).

A hare needs sharp scissor like incisors to bite off fresh green plant leaves. It does not need canines as it does not kill other animals.

Activity 7 Page 62

You will need :

a small beaker
1 small spatula of sugar
5 ml of water
a dropper
jam jar
boiling water
forceps/tweezers
insect bottle
microscope slide
cover slide
microscope
fairly large grasshoppers, locusts
biosets ZS/3
bioviewers etc. as in pupils guide

P

N. B.

Remind pupils to bring the insects listed in their guides . You can give the most helpful pupils an old matchbox or a jam jar for live flies or locusts.

Put some fresh grass in the insect cage with the locusts. Leave a handlens next to the cage so that the jaws move sideways, not up and down as ours do.

Out of sight of the pupils you should have killed a large grasshopper/locust. Holding its head firmly in left hand, use forceps to pull of the mouth parts one by one and place them with a drop of water on your microscope slide or biomount,

Start with the upper "lip"or tongue as it is called on the bioset. Remove by lifting and pulling with the forceps.

Next pull off the 2 side"jaws"which have ridged chewing edges. Last the two lower jaws, each of which has a little jointed feeler attached. These are to help direct the food into the mouth.

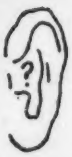
Arrange all the mouth parts on the slide as in the picture in the pupil'guide. p.62. If the insect is a large one, the pupils can look at the mouth parts using a handlens.

If it is a very small grasshopper, you may need to use a coverslide, and place the specimen under a microscope. This way pupils can see the hard cutting edges of the mouth parts. If you can find and kill enough grasshoppers, it is preferable for pupils to prepare their own biomounts of the insect mouth parts.

The Fly

Allow a few pupils to fetch some sugar water on a white lid. The jam jar containing the fly should be turned upside down next to the white lid. The lid of the jar should be carefully and quickly removed and the white lid slid under the jar. Provide a handlens and the pupils can go up one at a time to observe a fly feeding.

You should yourself kill one fly, and , using forceps remove the head and mount it on a slide. Put this under the microscope for the pupils to look at. Pupils should make their own biomounts of mosquitoes. You can put one under the microscope for them to look at.



Page 65 Ticks carry tick fever to humans, Biliary to dogs, Heartwater, gall sickness, redwater and East Coast fever to cattle.

These are serious diseases and cause weakness or loss of stock, so farmers should dip cattle regularly. The solution put into dip tanks is poisonous and kills the ticks. (Tsetse flies in some areas of Zimbabwe also carry parasites. One causes sleeping sickness in humans and a similar one causes nagana in cattle which causes them to die of the disease eventually.

PLANT PARASITES Page 65

Try to find some leaves which show black, or red/orange spots on them. These are easier to find underneath a leaf. You can tell the pupils that the leaves have been infected by a parasite. Grow some seeds in a tin of soil, keep moist and cover the young plants with a plastic bag. The plants should be left outside in a shady place in the container. A white powder like fungus may appear on the leaves. You can show the pupils that the plants have been attacked by a parasite.

Exercise 17 Page 65

1. A locust feeds on _____ and is a _____
2. A fly feeds on our food or _____
3. A mosquito and flea feed on _____
4. A locust has _____ mouthparts which are adapted for _____
5. A fly has _____ mouthparts which are adapted for _____
6. Mosquitos have _____ mouthparts adapted for _____
7. A locust _____ its food outside the body, It digest its food inside its body.
8. Flies, mosquitos and fleas start to _____ their food outside the body by pouring saliva on it.

Answers to Exercise 17

1. Plants - herbivore
2. Rotting material/rubbish/ waste
3. Blood
4. Chewing
5. Sucking
6.
7. Piercing and sucking
8. Chews and breaks up
9. Digest

Answers to : How much do you know? Part III Page 65

1. Short simple
2. Gut, human
3. Caecum. animal proteins, bacteria
4. Canine, plants
5. Canine. animals
6. Omnivores
7. Parasite
8. Sucking
9. Chewing
10. Mouthparts/gut, diet

Experiment 9 Page 68

Pupils will need basic kits
Have ready on your desk
Glucose and sugar
20 pieces universal indicator paper
Clean water.

The pH of the saliva will be neutral or slightly acid to start with. After a time the bacteria which have been washed off the teeth and are contained in the saliva will have acted on the sugar.
The waste materials which these bacteria produce will turn the solution acidic. The control will show no change

	pH at start of experiment	pH after several hours	pH next day
Bottle 1 with tooth washings			
Bottle 2 with control			

1. The pH of the bottle containing tooth washings changed from _____ to
2. The pH of the bottle with no tooth washings (the control) was _____
3. Therefore I think that _____
4. Toothpaste is the basic so that it can neutralise the _____ in the mouth.

Answers

1. As recorded by pupils
2. Not changed
3. Something in the tooth washings changed the pH of the sugar solution to become acidic.
4. Acid in the mouth.

EXPERIMENT 10 (Page 70)

To see what effect acid has on a tooth

You will need
2 teeth
hydrochloric acid
Pins
2 small plastic beakers
water
thread
measuring cylinder
In the first beaker put some water. In the second one put a little dilute acid

To Make up the Dilute Acid

Measure 5 ml hydrochloric acid in the 5 ml measure. Measure 20 ml water in the measuring cylinder. Pour the water into the plastic beaker and slowly add the acid.

Pass the teeth around with 2 pins and allow the children to try scratching the surface of each tooth with a pin. This is to see how hard the enamel is.
Then tie a thread around each tooth. Suspend one in the water and the other in the acid. When you wish to show the teeth again to the pupils, remember to rinse off the one which has been in acid before passing it around. The pupils will find that they can now penetrate the surface of this tooth when they scratch it with a pin. The tooth which has been in water will still be hard

N.B.

N.B. If you have no hydrochloric acid, you can use acetic acid diluted in the same way. Vinegar works well too.
You may be supplied with teeth. If not you may be able to obtain some teeth from a recently slaughtered sheep or goat at a butchery,

Page - Discussion and Talk

1. Main Ideas

Food can be removed from spaces with a chewed stick from bushes as ilala and muchakata . Teeth can be picked with a thin stick. A toothbrush can be used without toothpaste. Brushing should be done by sweep -ing the brush over the gum first, towards the tooth and then to the end of the tooth. Either brush down for top teeth, or up when cleaning teeth in lower jaw. Do not brush teeth from side to side as this pushes the gum

down and the dentine of the tooths root is exposed.
Brush at least twice per day.
A mouthful of water "swished"around in the mouth after a meal helps to dislodge food particles.

2. Clean teeth after each meal, or at least twice a day. Avoid sweet foods and drinks. If, occasionally, sugary foods are eaten, clean the teeth soon afterwards or swish clean water around in the mouth.

3. Toothpaste. Ask pupils to think back to Unit F2 and the work they did on acids and bases. They should recall that toothpaste was basic and will neutralise the acids in the mouth.

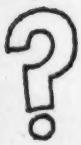
However the main use of toothpaste is that the small grains help the toothbrush to remove food particles.

Answers to Exercise 18

How to prevent tooth decay.

(1) Clean teeth several times a day with a brush or stick, and swish water around to remove food particles.
(2) Avoid eating too much sweet food especially last thing at night. If sweet food has been eaten swish out mouth with water afterwards or clean teeth.
(3) The use of toothpaste neutralises the acid in the mouth caused by bacteria.

Answers to How Much do you Know Part IV Page 74



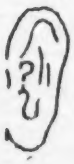
1. Dentine. enamel
2. Nerve, blood vessels
3. Fibres, cement
4. Sugary covering. acids, enamel
5. Base, neutralises, bacteria
6. Decay/decompose
7. Food, water

In warm climates, like we have in Zimbabwe, decomposer bacteria multiply rapidly in foodstuffs. Affected food contains both the bacteria and their wastes which cause diseases of the digestive systems to people who eat it. Diarrhoea is common in Zimbabwe, and is a killer in children because they lose fluids and salts from their body and become dehydrated . (First aid is a little glucose and salt in a lot of water).

Food which may still appear fresh can actually be dangerous to eat. One cannot judge by smell or looks alone - as children tend to do. It is important for them to have an understanding of food care, to protect their health.

Decomposer bacteria and fungus spores are very small and light. They are always present in the air and float down onto food. Food should be kept covered to minimise this.

POINTS TO REMEMBER ABOUT THE FOOD WE PREPARE



Living things cannot respire and reproduce at the very high or very low temperatures.

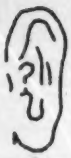
When a meal is prepared the cooked food should be kept hot until it is eaten. As food which is kept hot too long becomes dry and tasteless, it should be prepared just before eating. If food has to be prepared some time before eating, it should be cooled quickly, covered and kept in a refrigerator or a deep freeze. Deep frozen food will keep for a few months, food in a refrigerator for hours or a few days.

REMEMBER

Keep it hot
Keep it cold
or DONT KEEP IT!

Reheating food is undesirable. While it is being warmed up bacteria grow and multiply quickly. If food has to be reheated the heating must be done fast, and reach boiling water temperature to make sure the bacteria are killed.

Of course we cannot go out and kill our meat, pick our vegetables, grind our corn, milk the cow just before each meal - there are certain ways of keeping food for periods of time. See chart on methods of storing food on the next page.



The meat safe makes use of three factors

(1) Water
(2) Charcoal
(3) Air

(1) WATER: when water is exposed to air it evaporates. To do this it needs energy. In taking enough energy for some molecules to leave the liquid state and become a gas, the liquid left behind in the charcoal becomes colder. This cools the air inside the safe.

(2) CHARCOAL: When wood or coal has been burnt the charcoal left behind is like the sponge in the materials kit or it has a very large surface area. This means that evaporation is quicker and the charcoal becomes colder than say a wet stone with a smaller surface area. Old mealie cobs also have a large surface area.

The fact that the safe has sides and a bottom of charcoal, held in place with chicken wire, means that air can move around the charcoal freely causing quick evaporation and keeping the air cool inside.

(3) AIR

The safe should be kept outside, under a tree so that much air can blow around it. The principle of evaporation of water over a large surface is also used when water is kept hanging in an airy place in a canvas water bag. A small amount of moisture seeps through the canvas and evaporates on the outer surface. A baked, unglazed pot has a similar cooling effect,

A meat safe helps to keep food fresh and cool in areas where no electricity or gas are available. It keeps margarine from melting. drinks pleasantly cool on a hot day and vegetables crisper. It can also extend the life of fresh meat and milk by a few hours.
However it is not as good as a refrigerator for storing food, and cannot be used in the same way.

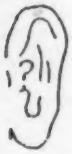
NOTES FOR THE TEACHER WHO DESIRES TO BUILD A MEAT SAFE

There is no space to give full details of how to make the safe. A carpenter from the village or teacher, should be able to copy it, as it is a very simple structure. It can be small or large according to the size required - her are some tips however. It does not have to be built in panels as suggested in the pupils diagrams. It is easier to build a frame, cover three sides inside with wire.

Placing the frame on its side, add the charcoal to 1 side first, then cover this with a rectangle of wire. Roll the safe over on to this finished side, and put charcoal in the next side until 3 sides have been done. Then similarly make a charcoal filled bottom and top to the safe. Make a separate door to fir the fourth side. A shelf inside the safe makes more space.

Water should be poured over the safe each day as well as being supplied by a tray and sacking or towel.

Newly Weaned Children



Mothers milk is balanced food for a young baby
Mothers milk is clean. Newly weaned children are exposed to 2 dangers

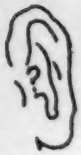
(1) Their diet may not be balanced any longer. Young children need a balanced amount of the right food.

(2) Bacteria may get into their food.

Milk is also an excellent food for bacteria, they breed fast in it. Young children are more easily affected by bacteria in their intestines than are adults and extra cleanliness is needed when preparing their food. Their drinking water should be boiled and cooled if it is not from a town tap. Each meal should be freshly prepared and clean utensils used.

Spaced families means that the young child is weaned off its mother's milk later in life and it has the advantage of clean balanced diet for longer.

Bottle Fed Babies

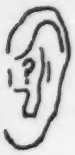


The 2 main dangers to babies fed on tinned milk are:

(1) Cleanliness of bottles. Dirty bottles contain bacteria. Bottles need to be boiled after washing.

(2) The baby food/milk powder must be mixed in right quantities to give a balanced diet. It should only be mixed with cooled boiled water.

Ways to Prevent Flies Getting at our Food



(1) Keep food covered with a lid or cloth. Food in a cupboard can be closed off from flies.

(2) Get rid of places where flies breed. Flies like to eat decaying material. They breed in dung, compost and rubbish. Compost heaps should be covered with soil. Rubbish bins should have lids on them. Litter should not be left lying around in streets or houses. Proper sanitation is important.

Human waste in particular should be kept away from flies. In town the waste is carried away by flush toilets to a special sewage "farm." Her the wastes are put in large tanks and broken down by decomposer bacteria.

(If you teach in an urban school you could take the pupils to a sewage farm it would make an interesting visit for them.)

In rural areas a lack of piped water means that a "pit"latrine or toilet must be used. The problem with these is that, although all the wastes are in one place, deep in the ground, the smell attracts flies. Flies enter the pit, breed there, and come out again carrying dirt, laden with disease micro-organisms.

Blair laboratories in Zimabbwe have come up with a clever solution to this problem.

The Blair Ventilated Privy (toilet)

These notes are just to explain the scientific principle behind the working of this type of toilet. Do not try to build one from these notes and the pupils diagrams alone. There is a proper way to build one, For instance the concrete slab must be reinforced and made of the correct mixture, or it may break up. The waste or squat hole must be the right size - big enough for cleanliness and small enough for safety. The pit must be a certain depth, and lined with plaster to prevent the sides falling in etc., and the toilet must be situated a long way from a well. A special screen has to be used on top of the chimney or "vent", made of fibreglass which is the right size and lasts a long time. Metal mosquito wire gauze breaks down and is useless in a short time.

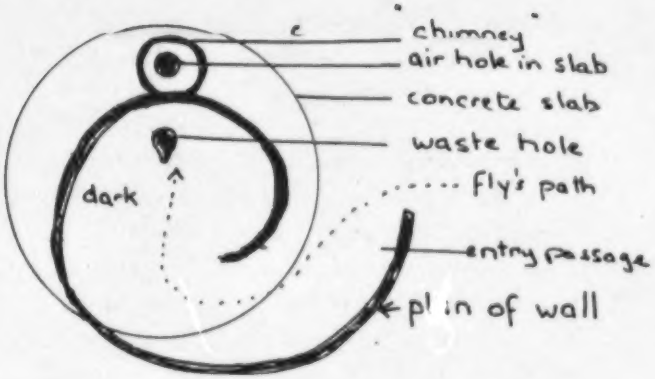
A toilet is quite easy and cheap to build, and the designers, Blair Laboratories can supply schools with full instructions to follow, and a free fibreglass screen:

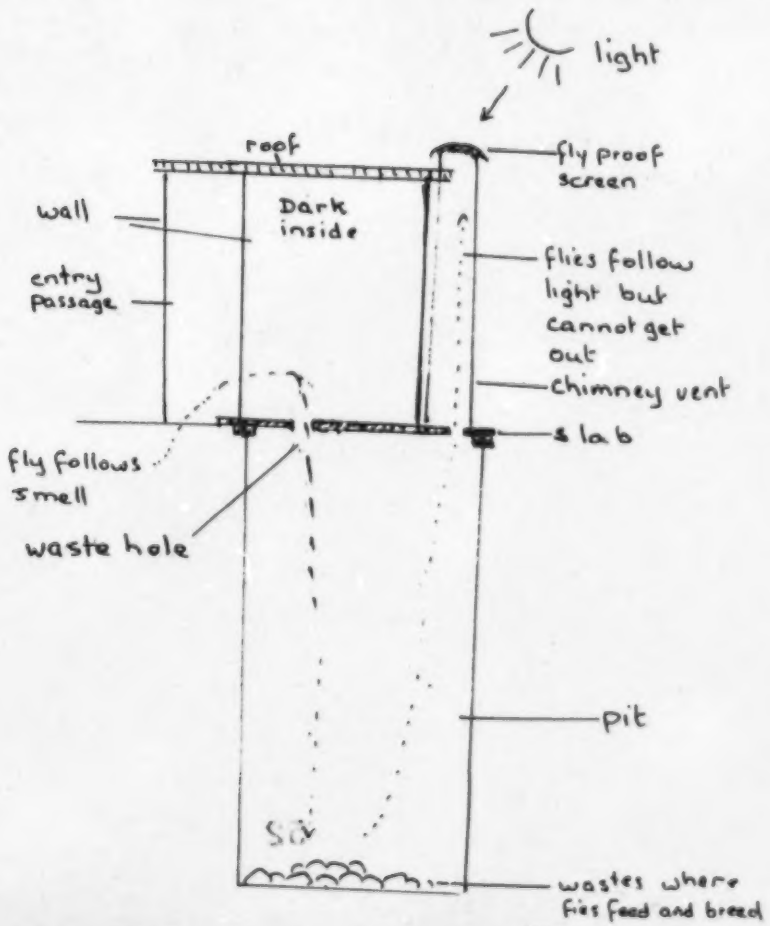
Write to : Blair Research Laboratories
North Avenue, Box 8105,
CAUSEWAY

for a free instruction booklet or consult you Extension Officer.

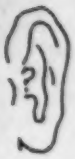
The Explanation

Put these diagrams on the board





49 Explain to the pupils : -



Firstly look at the shape of the wall. It is built in a spiral. like a snail shell. It has no windows. Light cannot get into the toilet as the spiral shape is designed to keep light out.

Flies are attracted by the smell of waste, and they find their way into the toilet by their sense of smell. They go down the waste hole into the pit where they may breed on the human waste.

What happens when they get out again? Their sense of smell cannot help them, so they have to use another sense, their sight.

Unfortunately for them they cannot see the way out through the waste hole as there is no light above it.

The only light they can can see is coming down the chimney, which we call a "vent" . They fly up the chimney trying to escape. What happens? They reach the top and their path is blocked by a fibre glass screen. This screen lets light and air through but not flies. They buzz away trying to get through until they die. This means that flies which have been on human wastes do not get to the peoples food to contaminate it.

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METHODS OF STORING FOOD

FREEZING	DRYING	CANNING	REFRIGERATING
Properly prepared foods can be kept for long periods. They should be sealed in plastic bags or containers and cooled quickly. Foods are safe if they are not defrosted and re-frozen. Frozen meat keeps longer than frozen fish or vegetables	Dried foods such as flour, beans and nuts keep for long periods. Small fish and thin strips of meat can be salted and dried quickly. Leaf vegetables and thin strips of of other plants can be air dried. There will be a loss of original flavour. May be invaded by insects such as weevils.	In factories food is cooked and sealed in containers while still boiling hot. This means bacteria are not present and the food should keep for years. However sometimes. bacteria get in accidentally. Bulging or "Blown" tins show that the gas has been given off because of bacteria Choose undamaged tins when you buy' Once opened canned food only keeps a short time. It should be used up immediately.	Foods keep a few days longer than at room temperature. Cooked food can be kept sealed. Uncooked foods should be covered or wrapped but not sealed. Dangers : Temperatures may vary, keep cooked foods in the coldest part of the refrigerator.